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BEES OF THE GENERA AGAPOSTEMON AND AUGOCHLORA IN THE COLLECTION OF THE CALIFORNIA ACADEMY OF SCIENCES

BY T. D. A. COCKERELL

The brilliant green bees belonging to these genera are among the most attractive in our fauna.

Genus AGAPOSTEMON (Guérin) F. Smith

AGAPOSTEMON COLORADENSIS Crawford, 1901

Females. *Utah*: Salt Lake City, July 1 (Van Duzee); Mount Timpanogos, 8-9000 feet, June 6 (Van Dyke).

AGAPOSTEMON VIRESCENS (Fabricius)

The names *nigricornis* (Fabricius), *vitreus* (Harris) and *bicolor* Robertson refer to the same species.

Females. *New York*: Ithaca, September 15 (Van Dyke); *Utah*: Garfield, June 28 (Van Duzee); *Oregon*: Corvallis, June 11 (Van Duzee).

Agapostemon martini Cockerell, n. sp.

Female (type). Length about or nearly 11 mm.; head and thorax emerald green with white pubescence; abdomen black with very broad and conspicuous bands of creamy white tomentum. Closely allied to *virescens* (Fabr.), but the hind tibiae have no band of dark fuscous hair on outer side, and the posterior truncation of meta-thorax lacks the well-defined transverse ridges. The base of the mandibles is black or almost so, instead of dull yellow. The basal hair on first abdominal segment is much more dense. The anterior margin of the clypeus is entirely black.

Male. Superficially like *A. virescens* but differing thus: green of head and thorax yellower, the face golden green; hair of face and thorax above tinged with fulvous; scape yellow with a black stripe behind; anterior and middle femora entirely yellow; trochanters yellow; venter of abdomen mainly yellow, last segment not keeled apically. The moderately stout hind femora are toothed below.

Type, female, No. 2461, Mus. Calif. Acad. Sci., collected by J. O. Martin, August 2, 1924, at **Patagonia, Arizona**. *Paratypes*: Baboquivari Mountains, Arizona, O. C. Poling (presented by C. L. Fox), females August 18, October, males, August 10, 18, 20.

AGAPOSTEMON MELLIVENTRIS Cresson

Females. *California*: Palm Springs, March 25 (J. O. Martin); Coachella, May (Van Duzee). Males. *California*: San Pedro, October 25 (G. R. Pilate); Needles, November and December (J. A. Kusche). The San Pedro-males have the black bands on abdomen averaging broader than in those from Needles. The latter are typical of the species.

AGAPOSTEMON SPLENDENS Lepeletier

Females. *Ohio*: Cedar Point, Sandusky, June 30 (Van Duzee).

Agapostemon epichryseus Cockerell, n. sp.

Male. Size and general appearance of *A. digueti* Ckll., differing thus: head and thorax above with abundant erect light golden hair; face broader; clypeus shorter; antennæ more robust and moniliform, black above, beneath yellowish ferruginous with the bases of the joints dusky; mesothorax densely granular, dull; base of metathorax bluer green, shorter and more rugulose; nervures darker; wings dusky at apex; middle and hind tibiæ with well-defined brown bands on basal part; abdomen with five yellow bands, separated by equally broad black ones; base of first segment black, but at extreme base with two large reddish yellow spots; venter orange with reddish bands, no special structural characters. Hind femora simple.

Type, male, No. 2462, Mus. Calif. Acad. Sci., collected by Albert Koebele in Morelos, Mexico, and presented to the Academy by Mr. W. M. Giffard.

This is certainly distinct from the closely allied *A. digueti* and *A. melliventris*. In Vachal's table it comes nearest to *A. leunculus* (Vachal), but that has the basal half of the first abdominal segment all black, and nothing is said of any reddish or golden hair above. Also our insect has the hind coxæ bright green above, not black. It also appears to resemble *A. sulfuripes* Friese from Costa Rica, but that really belongs to a different group with metallic color on abdominal bands and the hair whitish. The color of the dorsal pubescence suggests that this may be the male of *A. vulpicolor* Crawford from

Costa Rica, but the latter has duskier wings and the first recurrent nervure much nearer the end of second cubital cell.

AGAPOSTEMON COCKERELLI Crawford

Females. *Arizona*: Baboquivari Mountains, July 10, August 5 and 20 (O. C. Poling); two miles east of Oracle, July 24 (Van Duzee); fourteen miles east of Oracle, July 27 (J. O. Martin). *Utah*: King Station, Davis County, July 24 (Van Duzee).

Males. The male has not been described, but I refer here two specimens collected in *Arizona*: Baboquivari Mountains, August (O. C. Poling), and *Utah*: Zion National Park (Argus Mountain, Woodberry). The Arizona one has the yellow band on clypeus with pointed projection above, lacking in the Utah specimen. The latter may possibly be distinct.

This male is very like several others and especially allied to *A. cyanozonus* Ckll. The salient characters are: Head and thorax emerald green with pure white hair; scape black with yellow line or stripe in front; flagellum yellowish ferruginous beneath, black above; fourth antennal joint not quite as long as second and third combined; mesothorax excessively densely punctured, dullish; base of metathorax rugose but without well-defined plicæ, a median triangle bluer green than the rest; coxæ green; trochanters black (or first four with a little yellow); all femora and tibiæ with black marks, small but distinct on outer side of hind tibiæ; hind femora moderately stout, toothed; wings hyaline, second cubital cell broader than high. Abdomen with five yellow bands, the black bands between as broad as the yellow, posteriorly more or less blue; venter yellowish with strong reddish suffusion, first segment with green in middle apically emarginate; fourth with a thickened black curved callus, interrupted in middle; last without keel. The dorsal pubescence on apical segments light.

In Crawford's table this runs to *A. texanus* Cresson except that the hind tibiæ are not heavily marked with black. This is a variable character, but *A. cockerelli* does not have the large green triangular space on fourth ventral segment seen in *texanus*. The latter is also a larger insect.

AGAPOSTEMON VANDYKEI (Cockerell)

Females. *California*: Yosemite Valley, June 8 (Van Dyke); Carrville, Trinity County, July 6 (Van Dyke). I described this as a race of *A. texanus*, but I think it may stand as a distinct species.

AGAPOSTEMON ANGELICUS Cockerell

This species, described from Angel de la Guarda Island, Gulf of California, proves to have a wide range, even to Santa Fé, New Mexico.

Females. *Arizona*: Douglas, May 15 (J. I. Carlson); two miles east of Oracle, July 24 (Van Duzee); Warren, Cochise County, June 7 (J. I. Carlson); Prescott, June 7 (J. A. Kusche). *New Mexico*: Santa Fé, July 21 (Van Dyke); Santa Fé Cañon, July 23 (Van Dyke).

Males. The male has not been described. I refer here, not without some hesitation, the following specimens: *Arizona*: Grand Cañon, July 26 (Van Dyke). *Utah*: Saltair, July 12 (Van Duzee). *California*: Needles, December 11 (J. A. Kusche).

The male has the mesothorax green, granular and dullish, as in males of *texanus*. The Grand Cañon one is a little larger and has the scape wholly black, whereas the others have a yellow line on the scape. Male *A. californicus* varies in the scape in the same manner. The trochanters are black suffused with green (especially the hind ones) and the hind tibiae have a dark mark on outer side, characters of *A. fasciatus* Crawf., but that has the scape entirely yellow in front and the first abdominal segment yellow basally instead of broadly black as in the male now described. *A. fasciatus* also has the abdominal bands black, whereas they are posteriorly blue in the present form. There are five yellow bands on abdomen; pubescence of apical segment light; hind femora of the moderately thickened type, with tooth; last ventral segment without median carina, except a faint one, not apical, in Grand Cañon specimen; yellow band on clypeus with evident dentiform angle above.

These characters together exclude the species from Crawford's table, but it falls close to *A. texanus*, as the male of *A. angelicus* should. The rugæ at base of metathorax are not as distinct as in female *A. angelicus*. The latter, however, is variable and some specimens approach *A. texanus*. Perhaps *A. angelicus* is to be regarded as a subspecies of *A. texanus*, but if the male is correctly referred it seems to emphasize the distinctness.

AGAPOSTEMON BOREALIS Crawford, 1901

Females. *Washington*: Seattle, June 19 (Van Duzee). The dorsal thoracic hair varies from distinctly yellow to practically

white. The separation of this species from *texanus subtilior* becomes difficult, and I am not sure that *A. borealis* is really a distinct thing. There seems to be no essential difference in the base of the metathorax, nor in size. The single type of *borealis* was rather large (12 mm.).

AGAPOSTEMON TEXANUS Cresson

Females. *Arizona*: Chiricahua Mountains, Cochise County, March 26 (V. W. Owen). *Utah*: Heber, July 5 (Van Duzee); Salt Lake City, June 9 (Van Dyke), June 25, July 23 (Van Duzee).

AGAPOSTEMON TEXANUS SUBTILIOR Cockerell

Females. *Utah*: Logan, July 14, (Van Duzee); Vivian Park, July 7 (Van Duzee). *Oregon*: Hood River, June 12 (Van Dyke).

This form was described in *Entomological News*, ix (1898), p. 27, from Washington State. It looks distinct when compared with typical *A. texanus*, but in the Rocky Mountain region intermediates occur so that it is difficult to say where *subtilior* leaves off and *texanus* begins. It is thus the weakest of the *A. texanus* segregates, unless the male can be shown to differ in its structural characters. From Eldora, Colorado, I have what I regard as male *A. texanus subtilior*, and in *Psyche*, 1910, p. 244, I have given the differences from *A. texanus*.

AGAPOSTEMON RADIATUS Say

Females. *Colorado*: North Cheyenne Cañon, Colorado Springs, June 27 (Van Dyke), unusually slender. *New York*: Ithaca, July 14 (Van Dyke).

In *Entomological News*, ix, p. 27, I note: "Mr. Kincaid sent eighteen examples of *A. radiatus*, all from Pasco (Washington). The Pasco examples are larger and bluer than the Illinois form of *radiatus*." These supposed *radiatus* were undoubtedly *A. femoratus* Crawford, not then described.

AGAPOSTEMON FEMORATUS Crawford

Crawford describes this from Washington, California, and Idaho. As he does not indicate which is the type locality I will designate **Palo Alto, California**.

Males. *California*: Huntington Lake, Fresno County, 7000 feet, July 4-24 (Van Duzee); Stockton, August 29 (Van

Duzee); hills back of Oakland, August 2 (Van Dyke).

Females. *California*: Panoche Cañon, Fresno County, April 29 (Van Dyke); Diablo, May 13 (Van Duzee); Bradley, April 20 (Van Duzee); Panoche Hills, Merced County, April 29 (Van Dyke); Alameda County foothills (W. M. Giffard); Dulzura, San Diego County, April 10 (J. I. Carlson); Huntington Lake, July 8 and 16 (Van Duzee).—*Oregon*: Warner Mountains, Lake County, June 20, 21 (Van Dyke). *Idaho*: Payette, June 29 (Van Dyke). A yellower green than the Oregon specimens, the color practically as in *A. radiatus*, but size of *A. femoratus*.

The female is larger and usually bluer than in *A. radiatus*, but would hardly be considered a different species but for the distinct male with remarkably swollen hind femora. Crawford reports *A. radiatus* from California, but no particulars are given.

AGAPOSTEMON CALIFORNICUS Crawford

Crawford does not specify the type locality; I choose from those he cites **Pacific Grove, California**. His supposed female of this species from Moscow, Idaho, is something else, perhaps a form of *A. femoratus*. The true female is very close to *A. texanus*. The male has a very blue thorax.

Males. *California*: Pacific Grove, September (Blaisdell); Mesa Grande, Sonoma County, July 14 (Blaisdell); Tomales Bay, September 9 (Van Dyke); Santa Monica, September (F. C. Clark); San Francisco, September 8 (Van Duzee); Millbrae, September 1 (Van Dyke, Blaisdell); hills back of Oakland, August 2 (Van Dyke, Giffard); Carmel, August 20 (L. S. Slevin); Santa Barbara (Giffard); Alameda (Koebele); Concord (Ethel Crumb).

Females. *California*: Claremont (C. H. Muzzall); Cayton, Shasta County, July 9 (Van Duzee); Colton, May 26-28 (Van Duzee); Pismo, April 25 (Van Duzee); Needles, December 11 (J. A. Kusche); Mesa Grande, Sonoma County, July 14 (Blaisdell); Carmel, August, September (L. S. Slevin); Atascadero, April 26 (Van Duzee); Millbrae, September 1 (Van Dyke); Santa Monica (F. C. Clark); Bradley, May 22 (Van Duzee); Pebble Beach, May 27 (Van Dyke); Stone Cañon, Monterey County, April 27 (Van Duzee); Laguna Mountains,

San Diego County, August (Van Duzee); hills back of Oakland, August 2 (Van Dyke, Giffard); Alameda, May 12 (Van Duzee); Santa Barbara foothills (Giffard). The females differ greatly in color, some being much bluer than others, but all seem to be one species.

The following key will facilitate the separation of the above species:

- | | |
|---|--|
| Females | 1 |
| Males, abdomen banded with black and yellow..... | 8 |
| 1. Abdomen fulvous | <i>melliventris</i> Cresson |
| — Abdomen black..... | 2 |
| — Abdomen green | 4 |
| 2. Large (12-14 mm. long); wings brownish.... | <i>coloradensis</i> Crawford |
| — Smaller (about 11 mm.)..... | 3 |
| 3. Hind tibiæ with a band of dark fuscous hair on outer side, | <i>virescens</i> Fabricius |
| — Hind tibiæ without such band of dark hair (for other characters see description)..... | <i>martini</i> Cockerell |
| (<i>A. fasciatus</i> Crawf. from Nebraska and South Dakota is not in the Academy collection. It is readily separated from the above by the yellow apical band on female clypeus. <i>A. nasutus</i> Smith, from Mexico also has such a band.) | |
| 4. Abdomen with brassy and coppery tints..... | <i>vandykei</i> Cockerell |
| — Abdomen without brassy or coppery tints..... | 5 |
| 5. Mesothorax finely and closely punctured, the punctures more or less of two sizes..... | 6 |
| — Mesothorax rugulose or coarsely punctured, the punctures not of two sizes..... | 7 |
| 6. Mesothorax highly polished, shining; base of metathorax with very distinct plicæ after the manner of <i>A. radiatus</i> (New Mexico, Arizona) | <i>angelicus</i> Cockerell |
| — Mesothorax shining; hair of thorax above usually ochraceous (Washington, B. C.)..... | <i>borealis</i> Crawford |
| — Mesothorax shining; hair of thorax above not ochraceous; base of metathorax granular or rugulose; abdomen with blue or purple tints (Washington, Oregon, Utah, Colorado)..... | <i>texanus subtilior</i> Cockerell |
| — Mesothorax moderately shining; base of metathorax more distinctly sculptured than in the last, without any specialized triangular area; pubescence not ochraceous (Texas and Iowa to Washington and California)..... | <i>texanus</i> Cresson* |

*Crawford's table of the *A. texanus* group is:
 Base of metathorax with indications of a triangular enclosure, *subtilior* Ckll.
 Base of metathorax without a triangular enclosure,
 Pubescence white or griseous; smaller species, *texanus* Cress.
 Pubescence ochraceous; larger species, *borealis* Crawf.

- Mesothorax dull, granular (California to Idaho).....
*californicus* Crawford
7. Large rough form, about 12-15 mm. long (New Jersey to Florida, west to Colorado).....*splendens* Lepeletier
- Smaller form (10-12 mm.) with very distinct abdominal bands, (Colorado to Arizona).....*cockerelli* Crawford
- Size as in the last, but abdominal hair bands slight or lacking (Eastern states to Rocky Mountains).....*radiatus* Say
- Larger (about 12-14 mm.), usually bluer (Pacific coast and Idaho).....*femoratus* Crawford
 (Crawford adds that *splendens* and *cockerelli* have a triangle of finer lines on base of metathorax wanting in the other two.)
8. Small species with slender hind femora, not dentate below; scape entirely yellow in front..... 9
- Mostly larger species, with stout femora; if small then femora dentate beneath and scape not all yellow in front.....10
9. Hair of thorax above fulvus (Mexico).....*epichryseus* Cockerell
- Hair of thorax above white (southern California to New Mexico).....*melliventris* Cresson
10. Scape broadly yellow in front, thorax emerald green.....11
- Scape dark in front or with a yellow line; thorax nearly always bluer, or blue, when with yellow line on scape, the yellow band on clypeus with no upward projection in middle.....12
11. Hind femora extremely stout, oval.....*femoratus* Crawford
- Hind femora not thus stout.....*martini* Cockerell
12. Hind tibiæ with no black mark on outer side; last ventral usually without a carina; small or smallish forms; thorax green.....*angelicus* Cockerell
- Hind tibiæ with a black mark on outer side; thorax often blue 13
13. Thorax greener and abdomen largely yellow beneath.....
*cockerelli* Crawford
- Thorax mostly blue or bluish.....*californicus* Crawford

Several species in the Academy collection are represented only by females. The following table, mainly based on that of Crawford, will be useful for the separation of the males of these species:

- Hind femora greatly swollen or incrassate..... 1
- Hind femora slightly or not swollen..... 2
1. Larger; hind femora about half as long as broad....*splendens* Lep.
- Smaller; hind femora nearly as broad as long....*femoratus* Crawf.
2. Smaller, under 9 mm. long; scape of antennæ yellow or with a brown dot above.....*melliventris* Cress.
- Larger, over 9 mm. long..... 3

3. Head and mesothorax above blue..... 4
 —. Head and mesothorax above green; yellow band on clypeus
 more or less angulate above..... 5
 4. Larger; yellow band on clypeus angulate ("toothed") above;
 no keel on last ventral segment.....*coloradensis* Crawf.
 —. Smaller; yellow band on clypeus not angulate above.....
*californicus* Crawf.
 5. Abdomen with six yellow bands; pubescence on apical seg-
 ments dark.....*radiatus* Say
 —. Abdomen with five yellow bands; pubescence on apical seg-
 ments light..... 6
 6. Last ventral segment with a median carina.....*virescens* Fabr.
 —. Last ventral segment without a median carina; anterior and
 intermediate trochanters yellow to black (golden green in
A. fasciatus Crawf.).....*texanus* Cress.

Male *A. sulcatulus* Ckll. from Nebraska goes in the above table next to *A. melliventris*, but has the scape black with a broad yellow stripe in front. Disregarding size it would go to "5," but the band on clypeus is not angulate above. The dark callus on fourth ventral segment is entire, slightly arched; in *texanus* it is divided.

Female *A. pulcher* Smith, said to be from California, is said to be four lines long, entirely bright golden green, wings hyaline, legs rufotestaceous.

The genus *Agapostemon* is probably of South American origin, but it must have been in North America a long time. Its species or races seem to be rather vaguely defined, but possibly studies of the male genitalia would enable us to separate them more exactly. We need much more field work in order to correctly match the sexes, and determine the precise distribution of the various forms.

Genus AUGOCHLORA F. Smith

The type is *A. pura* (Say)

AUGOCHLORA IGNITA F. Smith

Mexico: Morelos (Koebele). Both sexes presented by Mr. W. M. Giffard. This differs from all others in the Academy collection by the crimson abdomen.

AUGOCHLORA FERVIDA F. Smith

Kansas: Lawrence, May 7-14 (F. X. Williams). *Arizona*: Baboquivari Mountains, August (O. C. Poling), presented by Mr. C. L. Fox; very many, including both sexes.

AUGOCHLORA POMONIELLA Cockerell

California: Santa Cruz Island, May 16, several (Van Duzee); Mill Creek Cañon, San Bernardino Mountains, September 21 (Van Duzee); Sobobo Springs, Riverside County, June 4 (Van Duzee); Colton, May 26-28 (Van Duzee); Stone Cañon, Monterey Co., April 21 (Van Duzee).

The Mill Creek Cañon series includes males. The male is more slender than the female, about 8 mm. long; antennæ black, the flagellum obscurely reddish beneath; clypeus strongly produced, the lower margin dark reddish; tarsi dark; margins of ventral segments entire, the fifth with a median carina. It is larger and greener than the male of *A. neglectula* Ckll. and the basal area of metathorax is considerably longer. In a male *A. pomoniella* from Claremont the flagellum is more strongly reddened beneath.

CALIFORNIA MICROLEPIDOPTERA II*

BY H. H. KEIFER

ARISTOTELIA ARGENTIFERA Busck

In late February of this year small larvæ were noted boring in the overwintering tips of *Baccharis pilularis* DC. in Marin County. The young early spring larvæ bore just below the tip of the branch under the epidermis, involving the parenchyma, but little of the woody core. Young larvæ noted after the new spring growth had started were tying the terminal leaves. Later the borings are used only for retreat and dense silken tubes extend to the leaves which are skeletonized. Mature larvæ have abandoned the borings and are found in tubes, tying the new spring leaves. Pupation takes place in a rather loose web in the rearing jars. Adults emerging April 4, May 11 and May 16 prove the larvæ to belong to this species.

Full-grown larvæ about 8 mm. long: body yellow-green, generally mottled whitish; six full length dorsal longitudinal whitish stripes, much broken; overlaid brownish pink between white markings, darker dorsally. Head variable, clear brown to mottled fuscous; shield green to fuscous; hairs light fuscous.

Pupa 5 mm. long, greenish yellow and entirely pubescent; head blunt; abdomen tapering to a rather acute anal end; wing cases, antennæ and hind legs ending on anterior part of sixth abdominal segment; abdomen with three movable segments; hooked hairs surround a well-developed cremaster.

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